

Overweight Children and Adolescents: Recommendations to Screen, Assess and Manage

Disclaimer: CDC has not established guidelines for the management of overweight in children and adolescents. This module provides recommendations that represent the consensus of a group of experts who manage overweight children and adolescents and that are derived from evidenced-based research when available.

Introduction

In recent decades the prevalence of overweight among children and adolescents has risen dramatically. As overweight becomes more common among children and adolescents, the associated chronic conditions and illnesses once prevalent only among adults begin to emerge in the pediatric population. Consequently, public health practitioners are focusing increased attention on preventing and managing overweight in childhood and adolescence.

To prevent and manage overweight in children and adolescents, those at risk of overweight or overweight must be correctly identified. Body Mass Index (BMI)-for-age growth charts for boys and girls aged 2 to 20 years are recommended for this purpose. The use of these charts to identify children and adolescents who are overweight and at risk of overweight is the focus of this module.

Objectives

Upon completion of this module, you will be able to

- Understand the definitions used to classify children and adolescents as overweight.
- Describe the medical consequences of overweight in children and adolescents.
- Use the CDC Growth Charts to plot anthropometric measurements.

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PREVALENCE OF OVERWEIGHT AMONG CHILDREN AND ADOLESCENTS

The prevalence of overweight among young people has increased dramatically. Between 1980 and 1994, children and adolescents considered to be overweight (BMI-for-age \geq 95th percentile) increased by 100% in the United States. Thirteen percent of children age 6-11 and 14 percent of adolescents age 12-19 are estimated to be overweight (National Center for Health Statistics, 2001). Previous data showed that approximately 11 percent of children and adolescents aged 6-17 were overweight (Troiano and Flegal, 1998). Overweight youth are more likely to be overweight as adults, and they are more likely to have medical risks associated with cardiovascular disease than are other children and adolescents (Whitaker et al., 1997; Freedman et al., 1999).

1. DEFINITION OF OVERWEIGHT

"At risk of overweight" and "overweight" are the terms preferred to refer to children and adolescents whose excess body weight could pose medical risks. Due to potential negative connotations associated with the term "obesity," "overweight" is preferred. Using the 2000 CDC growth charts, at risk of overweight for ages 2 to 20 years overweight is defined as a Body Mass Index (BMI)-for-age between the 85th and the 95th percentiles. Overweight in children is defined as a BMI-for-age at or above the 95th percentile on the charts. BMI is weight in kilograms divided by height in meters squared (kg/m^2).

While BMI is commonly used to evaluate overweight and obesity in adults, only recently has it been recommended to screen children and adolescents. An advantage of using BMI-for-age is that it can be used continuously from age 2 years through adulthood. BMI is used differently to define overweight in children and adolescents than it is in adults.

In children and adolescents, BMI changes with age and gender. As children age, BMI increases (Hammer et al., 1991; Pietrobelli et al., 1998). Therefore, BMI is plotted on a chart of the appropriate gender, relative to the child's age. BMI is evaluated using percentile cutoff points to compare values for a given child with other children of the same age and gender from a national reference sample. At the 95th percentile, very few children are incorrectly classified, although it is possible that some children with excess adiposity will fall below the 95th percentile and be missed in screening (Dietz and Bellizzi, 1999). To reduce the chance of missing at risk children, an additional BMI cut point at the 85th percentile was established. For these children, further assessment may be needed, as we will cover later in the module.

For adults, BMI is evaluated using arbitrary BMI cutoff point rather than percentiles. Cut points have been established to describe "overweight" (25-29.9) and "obesity" (≥ 30) (NHLBI, 1998).

2. CONSEQUENCES OF OVERWEIGHT IN CHILDREN AND ADOLESCENTS

Health consequences related to overweight can begin in childhood or adolescence; overweight children and adolescents are at increased risk for various chronic diseases in later life. In a study conducted by Freedman and colleagues (1999), nearly 60 percent of overweight children had at least one cardiovascular risk factor compared to 10 percent of those with a BMI-for-age \leq 85th percentile; 25 percent of overweight children had two or more risk factors. The psychosocial consequences of overweight are significant. Overweight in children has been linked to social discrimination, a negative self-image in adolescence that often persists into adulthood (Stunkard et al., 1967), parental neglect (Lissau and Sorenson, 1994), and behavioral and learning problems (Mellbin and Vuille, 1989).

- **Common Medical Consequences of Overweight** (Dietz, 1998)
 - **hyperlipidemia:** a group of disorders characterized by elevated levels of cholesterol, triglycerides, and /or low density lipoproteins (LDL) and low levels of high density lipoproteins (HDL) in the blood. Overweight in children increases the risk for cardiovascular disease and premature death in adulthood (Power et al., 1997; Must et al, 1992). Hyperlipidemia may improve with weight reduction (Caprio et al., 1996; Wabitsch et al., 1994). In a study by Freedman and colleagues (1999), 90 percent of the children with high levels of triglycerides were also overweight.
 - **glucose intolerance:** a precursor of diabetes. The incidence of non-insulin-dependent diabetes mellitus among adolescents is increasing and accompanying the national rise in overweight among teens (Pinhas-Hamiel et al., 1996). Acanthosis nigricans is associated with glucose intolerance in children and adolescents and is characterized by increased thickness and pigmentation of the skin between folds or juxtaposed surfaces (Richards et al., 1985).
 - **hepatic steatosis:** the fatty degeneration of the liver. High concentrations of liver enzymes are associated with hepatic steatosis and have been found in overweight youth (Kinugasa et al., 1984). Weight reduction causes hepatic enzymes to normalize (Vajro et al., 1994). Hyperinsulinemia also may play a role in hepatic steatosis (Wanless et al., 1989).
 - **cholelithiasis:** the presence of stones in the gallbladder, which occurs with more frequency in obese adults compared to other adults. Although gallstones occur less frequently among children and adolescents who are overweight than in obese adults, nearly 50 percent of the cases of cholecystitis (i.e., inflammation of the gallbladder) in adolescents may be associated with overweight (Crichlow et al., 1972). As in adults, cholecystitis in adolescents may be associated with weight reduction.
 - **early maturation:** early maturation, characterized by adolescents with a skeletal age > 3 months in advance of chronological age, is associated with increased fatness in adulthood (Van Lenthe et al., 1996a). It is also associated with an increase in the truncal distribution of fat in women (Van Lenthe et al., 1996b; Garn et al., 1986).

- **Less common medical consequences of overweight**

- o **hypertension**: persistently elevated blood pressure occurs with low frequency in children, although it has been found to occur approximately nine times more frequently among children who are overweight compared with other children (Lauer et al., 1975). In Lauer's study, almost 60 percent of children with persistently elevated blood pressure had relative weights >120 percent of the median for their sex, height and age. Childhood blood pressure and change in BMI were consistently the two most powerful predictors of adult blood pressure across all ages and both genders (Lauer et al., 1975). Freedman and colleagues (1999) found overweight children were 2.4 times as likely to have elevated diastolic blood pressure and 4.5 times as likely to have elevated systolic blood pressure.
- o **acute complications** are those that require immediate medical attention and should be referred to a pediatric obesity center (Barlow and Dietz, 1998).

Sleep apnea is the cessation of breathing lasting at least 10 seconds during sleep, characterized by loud snoring and labored breathing. During these periods, oxygen levels in the blood may fall dramatically. It is estimated that sleep apnea occurs in approximately 7 percent of obese children (Mallory et al., 1989).

Pseudotumor cerebri is characterized by increased pressure in the skull that causes headaches and is a rare disorder.

Obesity hypoventilation syndrome, also known as Pickwickian syndrome, may be a cause of sleep apnea but this remains unclear. Aggressive therapy is warranted for children with obesity hypoventilation syndrome (Riley et al., 1976).

A variety of orthopedic complications affecting the feet, legs, and hips can occur, including Blount disease and slipped capital femoral epiphysis.

3. SCREENING CHILDREN AND ADOLESCENTS FOR OVERWEIGHT

Information presented in the rest of the module includes recommendations that represent the consensus of a group of experts who manage overweight children and adolescents. (Barlow and Dietz, 1998). The recommendations are not evidence-based since few studies on evaluation and management of overweight children have been published.

BMI-for-age is recommended to screen children aged 2 to 20 years for at risk of overweight and overweight to identify children who may need further assessment and possible treatment. Plot weight on the weight-for-age chart and stature on the stature-for-age chart to determine the effect of weight and stature on BMI-for-age for an individual child.

Children should be accurately weighed and measured to monitor growth according to the periodicity schedule of the American Academy of Pediatrics (AAP): Recommendations for Preventive Pediatric Health Care (<http://www.aap.org/policy/periodicity.pdf>)

Considerations when screening for overweight:

- **Infants and children under the age of two years**

For infants and children under the age of two years, plot the weight-for-length, weight-for-age, and length-for-age CDC Growth Charts. Overweight, defined as a weight-for-length greater than the 95th percentile, does not pose the same risk among infants as it does among children 2 years and older. Overweight infants may not be at increased risk of being overweight in adulthood and they do not have the medical risks associated with overweight in childhood (Whitaker et al., 1997).

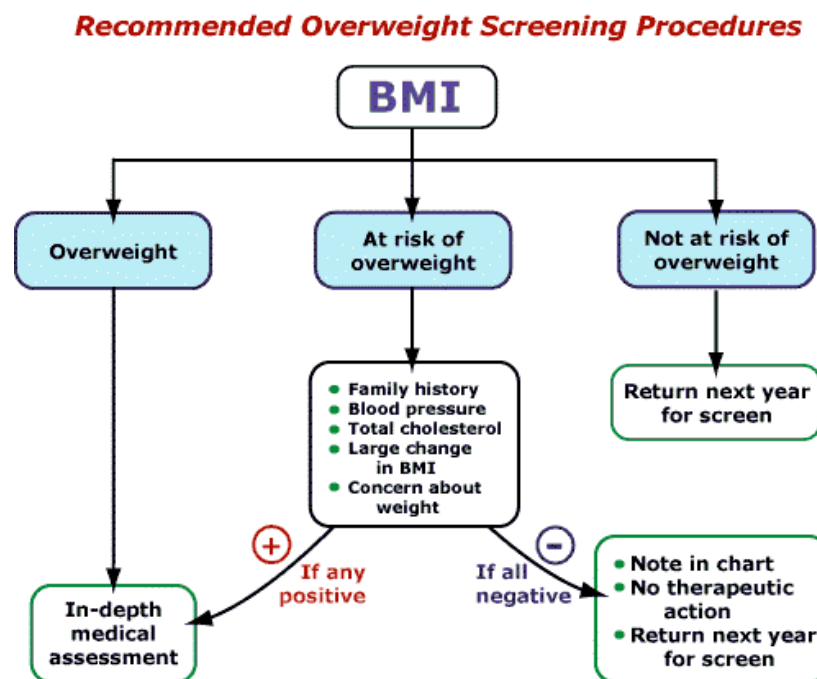
- **Children 24 to 36 months of age**

CDC recommends measuring stature for children 2 years and older who are able to stand on their own, calculating BMI and plotting it on the BMI-for-age chart. However, clinicians may choose to measure recumbent length and use the weight-for-length charts for children 2 to 3 years of age. Alternatively, the weight-for-stature charts can be used to plot stature from 77 to 121 centimeters. Whether the child's length or stature is measured determines which growth chart will be used. It is inappropriate to use a length measurement to calculate BMI-for-age. It is also inappropriate to use a stature measurement with either the length-for-age chart or the weight-for-length chart.

- **Adolescents**

Adolescence represents the period of greatest risk for developing adult obesity (Whitaker, 1997). Measures of weight relative to stature, like BMI-for-age, are influenced by pubertal status. For early or late maturing children, these indices should be interpreted with caution (Himes and Dietz, 1994; Daniels et al., 1997). To learn more about stage of maturation and how it relates to BMI, see the module on Adolescent Physical Development: Uses and Limitations of the Growth Charts.

Screening Procedure



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Children, 2 years and older, and adolescents with a BMI-for-age at or above the 95th percentile require an in-depth assessment and weight management. Further assessment will help verify excess body fat and determine if complications such as hyperlipidemia or hypertension are present that indicate a recommendation for weight loss.

Children and adolescents with a BMI-for-age between the 85th and 95th percentiles need further evaluation that might include a family history, the family's and/or the patient's concern about weight, blood pressure and total cholesterol screening, and determining if there has been a recent, large change in BMI-for-age.

Children and adolescents with a recent, large change in BMI-for-age should receive prompt evaluation. From about age 8 years, BMI values at each percentile increase annually 0.5 to 1 BMI unit. Although the degree of change that indicates risk has not been defined, an annual increase of ≥ 2 BMI units has been suggested to identify a rapid increase in body fat in most older children and adolescents (Himes and Dietz, 1994).

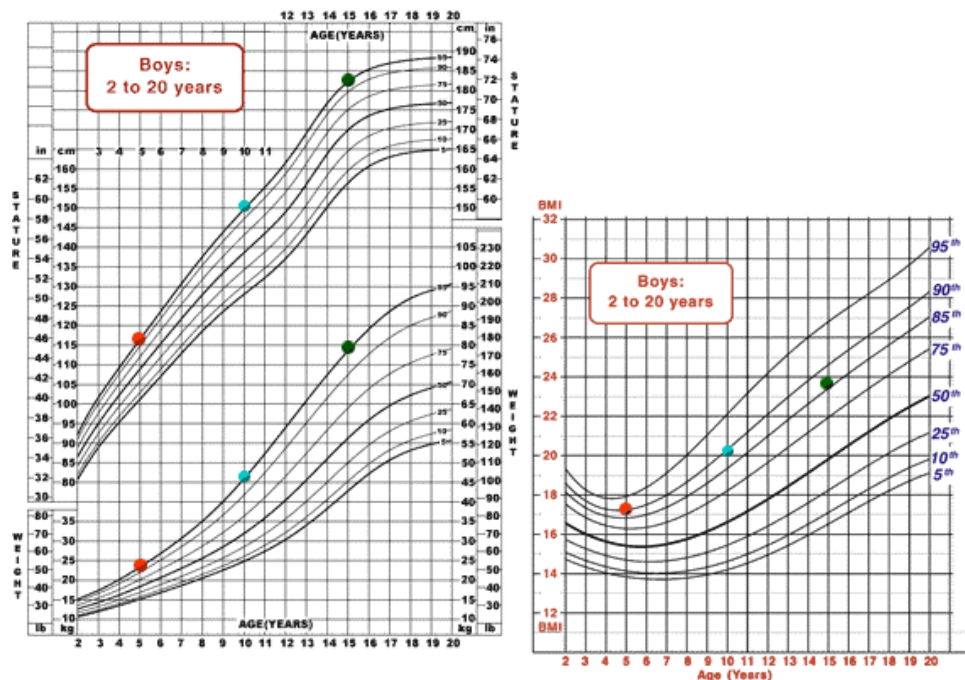
Weight-for-age and stature-for-age are useful indices to help monitor growth and, to interpret changes in BMI-for-age. However, they are incomplete screening indices by themselves and need to be used in combination with BMI-for-age. Weight-for-age reflects body mass relative to chronological age. Short-term changes, such as an increase in weight-for-age, may result in a change in the BMI-for-age. Likewise, changes in stature also affect BMI-for-age. The following examples demonstrate the advantages of using BMI-for-age in addition to weight-for-age and stature-for-age to screen for overweight.

EXAMPLE 1

Note: In this example, anthropometric measurements for three boys are plotted on one chart for illustrative purposes only. Typically, more than one child is NOT plotted on the same chart.

Three boys aged 5, 10 and 15 years, each have weight-for-age and stature-for-age measurements that plot at the 95th percentile. Using this information, we could conclude that all three boys are large for their age and, therefore, not overweight since both height and weight are at the 95th percentile. However, when the boys BMIs are plotted on the BMI-for-age chart, the 5-year-old and 10-year-old are at the 90th percentile, and the 15-year-old is at the 85th percentile. Each boy is actually at risk for overweight. This illustrates the importance of using BMI-for-age in addition to weight-for-age and stature-for-age to accurately assess whether or not a child is at risk of overweight or overweight. It is not recommended to use weight-for-age or stature-for-age independently to screen for risk of overweight.

	Age	Weight	Stature	BMI
Boy 1	5	51 3/4 lb	46"	17.2
Boy 2	10	101 5/8 lb	59"	20.5
Boy 3	15	173 5/8 lb	71 3/4"	23.7

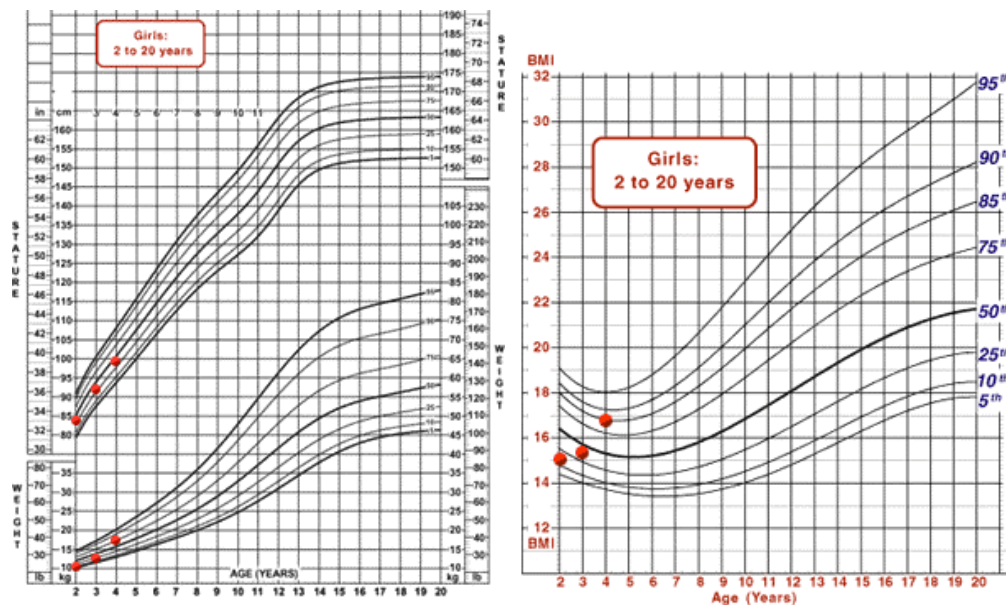


EXAMPLE 2

A girl's growth was screened at her annual visit by plotting stature-for-age and weight-for-age. When she was 2 years of age her stature-for-age was slightly above the 25th percentile and her weight-for-age percentile was below the 10th. Her height remained below the 50th percentile at age 4. In contrast, her weight continued to increase at a faster rate than height to the 75th percentile at age 4.

When her BMI-for-age is plotted, she is at the 85th percentile indicating that she is at risk of overweight. BMI-for-age considers her weight relative to height for her age and gender, and therefore is the recommended index to classify a child as overweight.

Age	Weight	Stature	BMI
2	23 1/4 lb	33"	15
3	28 1/2 lb	36 1/4"	15.4
4	36 1/2 lb	39 1/4"	16.8



4. ASSESSMENT OF OVERWEIGHT CHILDREN AND ADOLESCENTS

In-depth assessments are required to determine if children and adolescents with BMI-for-age \geq 95th percentile are truly overfat and at increased risk for health complications related to overweight. In-depth assessments allow for a diagnosis of the underlying causes of overweight and provide a basis for management plans. Among children over 7 years, practitioners should pay particular attention to family history and secondary complications of overweight, such as hyperlipidemia and hypertension. The child's or adolescent's concern about his or her own weight should also be taken into consideration before beginning a weight loss program.

An assessment might include the following:

- **Medical History** will help identify any underlying syndromes or secondary complications of overweight.
- **Family History** will identify familial risks for overweight/obesity. This includes the presence of obesity, eating disorders, type II diabetes, heart disease, high blood pressure, and abnormal lipid profiles (high cholesterol, abnormal lipid profile).
- **Dietary Assessment** will evaluate eating practices, including the quantity, quality and timing of food intake to identify foods and patterns of eating that may lead to excessive calorie intake. A 24-hour recall, food record, or food frequency method of diet assessment may be used.
- **Physical Activity Assessment** assesses daily activity levels. This assessment should include an estimate of time spent on exercise and activity, as well as time spent on sedentary behaviors, such as television, video viewing, and computer use.
- **Physical Examination** will provide information about the degree of overweight and any potential underlying complications of overweight such as high blood pressure. Those children and adolescents with a BMI-for-age at or above the 95th percentile and who are very athletic or whose family history suggests large frame size may be further assessed using triceps skinfold measurement to assess body fat (Barlow and Dietz, 1998). Although measurement of skinfold thickness can be unreliable, a measurement of greater than the 95th percentile measured by an experienced observer provides evidence that the child has excess fat rather than increased lean body mass or large frame size.

Smoothed 95th Percentiles of Triceps Skinfold Thickness for NHANES 1 Subjects¹

To determine triceps skinfold measurements: measure the midpoint between the acromion and olecranon process on the posterior surface of the right arm and mark it. With the patient's arm relaxed, grasp the skinfold about 1 cm above the midpoint, taking care to exclude muscle from the grasp. Measure skinfold thickness with calipers, such as Lange or Holtain calipers, that provide standardized pressure. Repeat two to three times.

Males	95 th percentile	Females	95 th Percentile
Years	mm	Years	mm
6-6.9	14	6-6.9	16
7-7.9	16	7-7.9	18
8-8.9	17	8-8.9	20
9-9.9	19	9-9.9	22
10-10.9	21	10-10.9	24
11-11.9	22	11-11.9	26
12-12.9	23	12-12.9	28
13-13.9	24	13-13.9	30
14-14.9	23	14-14.9	31
15-15.9	22	15-15.9	32
16-16.9	22	16-16.9	33
17-17.9	22	17-17.9	34
18-18.9	22	18-18.9	34
19-19.9	22	19-19.9	35

¹ Barlow SE and Dietz WH. Obesity recommendations and treatment. *Journal of Pediatrics* 1998; 102(3).

- **Laboratory Tests** to be administered will be determined by the degree of overweight, family history and results of the physical exam. A physician should schedule appropriate laboratory test such as cholesterol screening.

The resources below provide guidelines for identifying children and adolescents at risk of consequences of overweight:

Classification of cholesterol levels in High-Risk Children and Adolescents:

<http://www.brightfutures.org/nutrition/pdf/178-226.pdf> (PAGE 31)

Blood pressure levels for 90th and 95th percentiles of blood pressure for boys and girls aged 1 to 17 years:

<http://www.brightfutures.org/nutrition/pdf/178-226.pdf> (PAGES 35-36)

American Diabetes Association position paper on type 2 diabetes in children including recommendations for diagnostic testing:

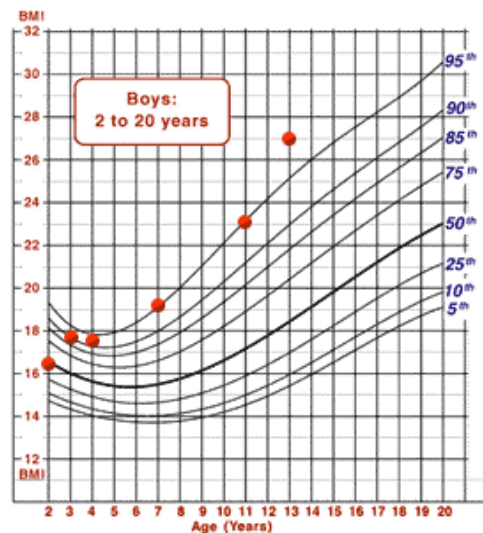
American Diabetes Association. Type 2 diabetes in children and adolescents. *Pediatrics* 2000; 105:3; 671-680.

- **Psychological Evaluation** may be needed for children and adolescents who require weight management to determine their readiness to change behaviors and to identify a history of eating disorders or depression which may require a referral. Also, evaluation of the parent's psychological readiness to change is important.

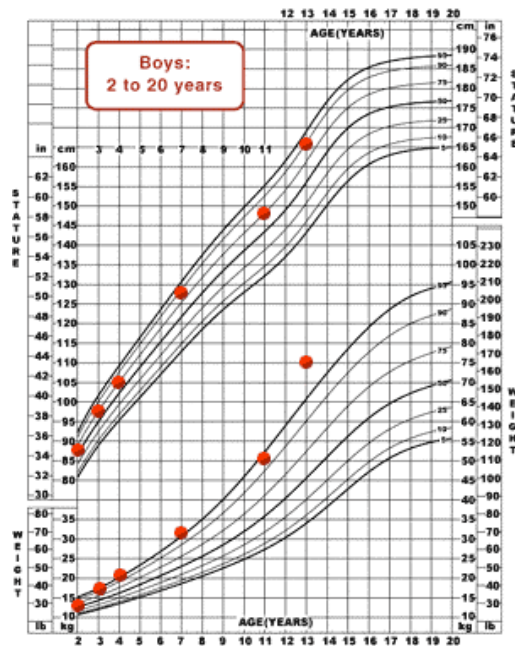
EXAMPLE 1: Screening and assessment for early childhood onset overweight

Screening: The growth chart shows the BMI-for-age pattern of a boy who became overweight early in his preschool years. On the BMI-for-age chart at age 2, he was at the 50th percentile; his BMI-for-age increased rapidly, crossing the 75th and 85th percentiles to become at risk of overweight at 3 and 4 years old. His BMI-for-age continued to increase to above the 95th percentile at age 7, 11, and 13 years.

Age	Weight	Stature	BMI
2	28 1/4 lb	34 3/4"	16.4
3	38 1/4 lb	38 7/8"	17.8
4	43 1/2 lb	41 5/8"	17.6
7	69 1/4 lb	50 3/8"	19.2
11	111 lb	58 1/8"	23.1
13	166 1/4 lb	65 3/4"	27



To understand how changes in weight and stature contributed to the increase in BMI-for-age, it is helpful to review the weight-for-age and stature-for-age curves. His stature-for-age at age 2 was above the 50th percentile and it increased to above the 90th percentile by age 13. However, his weight-for-age increased more rapidly than stature, i.e., from the 50th percentile at age 2 to greater than the 95th percentile at age 13, which contributed to the increase in BMI-for-age.

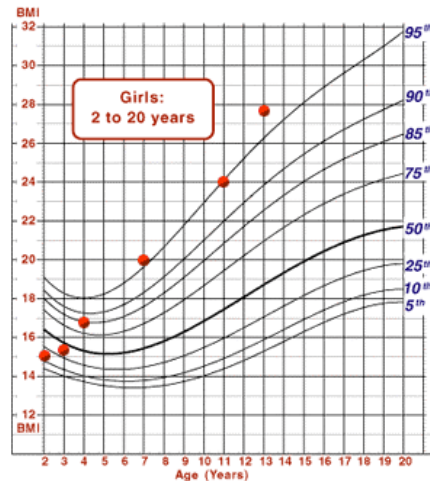


Assessment: When this boy was identified as at risk of overweight on the BMI-for-age chart at age 3, he should have received a medical assessment, as well as additional nutrition and physical activity assessments. The information from the assessments could have been used to target efforts for appropriate weight management goals to prevent the development of overweight.

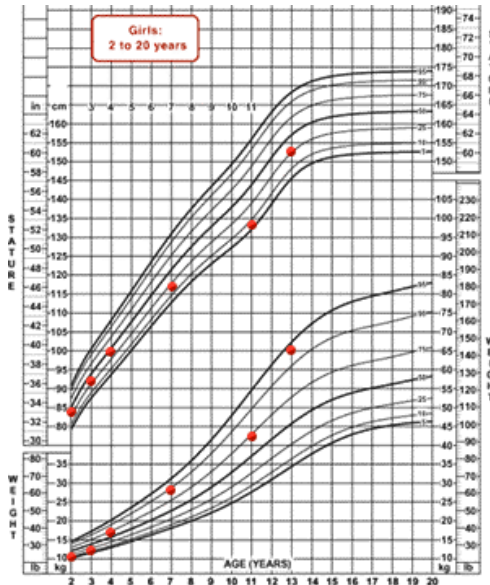
EXAMPLE 2: Early adolescent onset overweight

Screening: The BMI-for-age chart shows the growth pattern of a girl who was classified as overweight at 7 years of age. Her growth pattern shows that at age 2, her BMI-for-age was at the 15th percentile and then moved rapidly upward crossing the 25th, 50th, and 75th percentiles at 4 years of age. This upward trend continued to age 7, when BMI-for-age was at the 95th percentile.

Age	Weight	Stature	BMI
2	23 1/4 lb	33"	15
3	28 1/2 lb	36 1/4"	15.4
4	36 1/2 lb	39 1/4"	16.8
7	60 lb	46"	20
11	94 1/2 lb	52 3/4"	24
13	143 lb	60 1/4"	27.7



To understand how changes in both stature and weight affect BMI-for-age, review the weight-for-age and stature-for-age charts. When this girl was 2 years old, her stature-for-age was slightly above the 25th percentile and the weight-for-age percentile was below the 10th. Her stature remained below the 50th percentile and dropped to a lower percentile as she got older. In contrast, her weight-for-age continued to increase at a faster rate than stature-for-age except between 7 and 11 years of age. Notice that a decrease in her weight-for-age was not reflected as a decrease in BMI-for-age because her stature-for-age percentile also decreased. As a result, she was still overweight at age 11 and 13.



Assessment: This girl should have received further assessment when she first was identified as at risk of overweight at age 4. This would have been warranted since her BMI-for-age increased from the 25th percentile to the 85th percentile between ages 3 and 4 years. Further assessment might have included family history, parental concern about her weight, and dietary and physical activity assessments. From this information, appropriate weight management goals could have been instituted.

5. MANAGEMENT OF OVERWEIGHT CHILDREN AND ADOLESCENTS

Strategies used in a management plan are based on information obtained from the assessment. Weight loss is recommended if complications such as hyperlipidemia or hypertension are identified and for children 7 years or older with a BMI-for-age $\geq 95^{\text{th}}$ percentile. Otherwise, weight maintenance is recommended.

Recommendations for Weight Management

- **Infants and children up to age 2 years**

Since infancy is a period of rapid growth and appropriate weight gain is important during infancy, weight loss is generally not recommended (Kleinman, 1998). However, health care providers may determine that follow up is appropriate in certain circumstances (e.g., delayed motor development due to excess body weight) and refer children younger than 2 years to a pediatric obesity center.

- **Children age 2 to 7 years**

Weight maintenance

For those at risk of overweight or overweight with no identified complications, maintenance of current weight is recommended which can be achieved with changes in diet and activity. Promote healthy eating and increased physical activity and follow-up with an annual screening. Prolonged maintenance will allow a gradual decline in BMI units (and BMI-for-age percentile) as children grow in height.

Weight loss

If complications are identified and BMI-for-age is $\geq 95^{\text{th}}$ percentile, gradual weight loss is recommended. Weight loss in children should be recommended with caution and should generally be no more than one pound per month.

- **Children age 7 years and older**

Weight maintenance

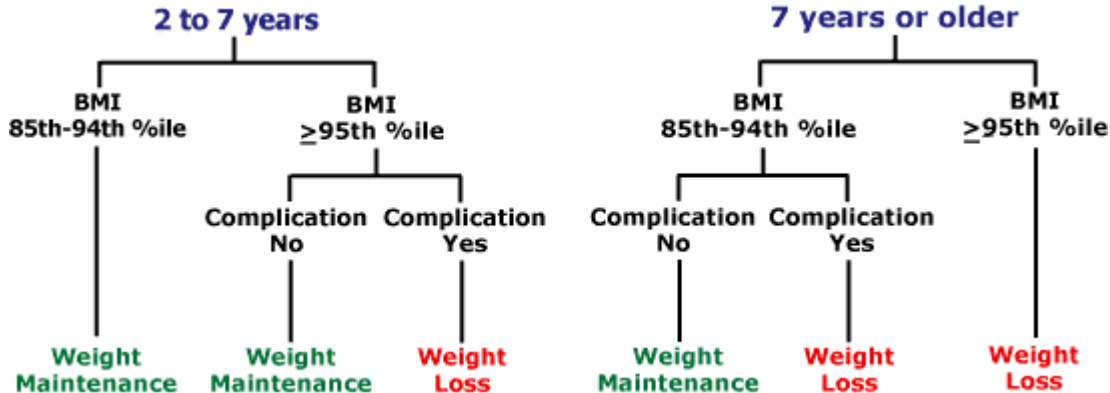
For those at risk of overweight with no identified complications, weight maintenance is recommended.

Weight loss

For those overweight and those at risk of overweight with complications, weight loss is indicated. In older children and adolescents who are markedly overweight i.e., a BMI >35 , and whose health risks are acute, 1 to 2 pounds per week may be warranted. An appropriate final goal for all children and adolescents who are overweight or at risk of overweight is a BMI-for-age below the 85th percentile. The rate of weight loss should be based on health risks and balancing the costs and benefits of loss versus those risks.

Although BMI-for-age percentiles are used to monitor children and adolescents, in those who are markedly overweight the actual BMI value should be the basis for the recommendation. A BMI of 35 or more indicates that the child or adolescent is at least 60 pounds heavier than a child with a BMI-for-age at the 50th percentile. For example, for a 10-year-old boy or girl, a BMI of 35 indicates that they are about 78 pounds heavier than a 10-year-old whose BMI-for-age is at the 50th percentile. Note that actual BMI at the 50th percentile for 10 year old boys and girls is approximately 16.5). At age 13 years, a BMI of 35 will make the adolescents roughly 90 pounds heavier than those with a BMI-for-age at the 50th percentile. Children and adolescents with a BMI > 35 may have difficulty substantially increasing physical activity levels.

Recommendations for weight management for children and adolescents 2-20 years old



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Complications

For those with complications, improvement or resolution of the condition is an important goal. For example, an abnormal blood pressure or lipid profile may improve or return to within a normal range with weight management.

Acute complications such as sleep apnea, and pseudotumor cerebri, as well as orthopedic problems, should be referred to a pediatric obesity center (Barlow and Dietz, 1998).

Individualized recommendations

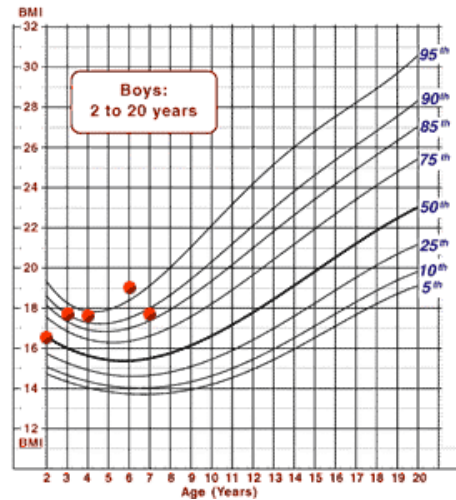
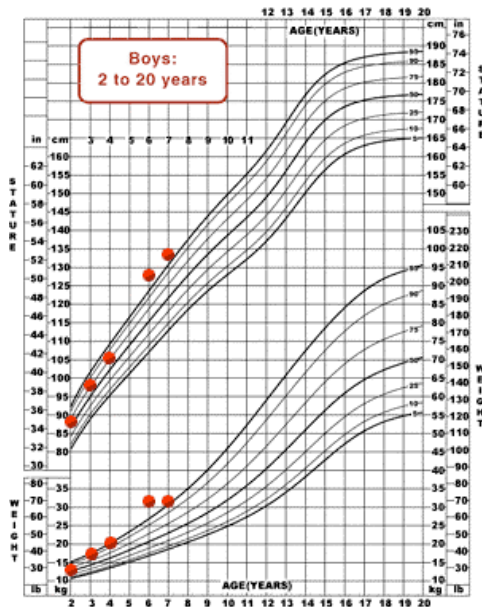
Each family has its own set of supports and stresses. Because success with weight management can be difficult to achieve, recommendations for change must consider the family's readiness for change, family support, financial concerns, and neighborhood characteristics (including access to play areas and grocery stores). Unless the situation is understood fully, recommendations for change may not be targeted appropriately.

Treatment should begin early, involve the family, and institute permanent changes in a stepwise manner. Parenting skills are the foundation for successful intervention -- that include gradual targeted increase in physical activity and targeted reductions in high-fat and high-calorie foods.

EXAMPLE 1: Weight maintenance

This chart shows the BMI-for-age pattern of Juan who became at risk for overweight at age 3. An intervention was not recommended until age 6, when Juan's BMI-for-age indicated overweight. At age 6 a medical assessment revealed no complications, and weight maintenance was encouraged. Over the course of the next 12 months his weight remained 69.3 pounds and his height increased to 52.6 inches. During this period, Juan's diet was carefully monitored by the family with the help of a dietitian. Over the year, BMI decreased as height continued to increase relative to weight and by age 7 years, his BMI-for-age was slightly above the 85th percentile. A BMI-for-age below the 85th percentile is an appropriate goal based on the child's growth trend until age 6 and because he was without secondary complications. Consequently, Juan needs continued monitoring to reach the goal.

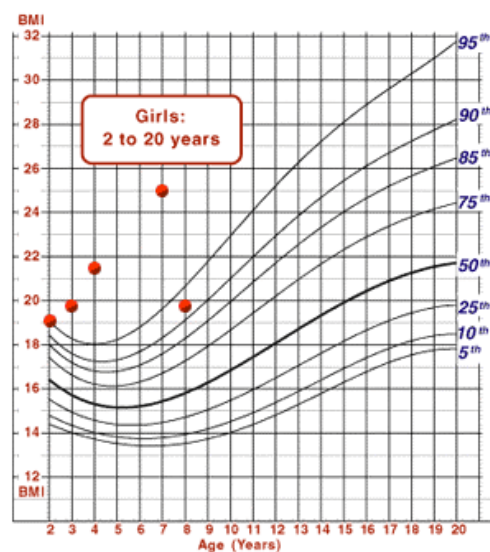
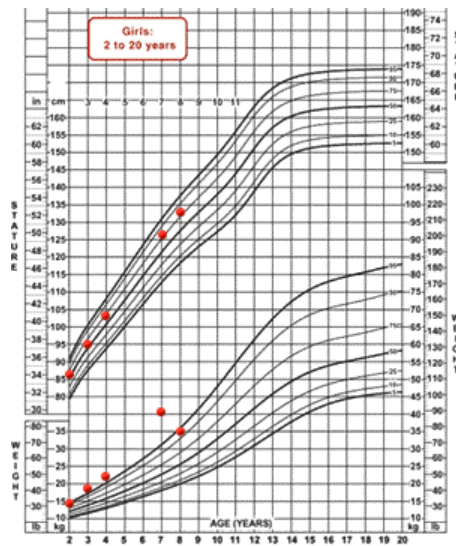
Age	Weight	Stature	BMI
2	28.4 lb	34.8"	16.6
3	38.1 lb	38.9"	17.8
4	43.6 lb	41.6"	17.7
6	69.3 lb	50.5"	19.1
7	69.3 lb	52.6"	17.7



EXAMPLE 2: Weight loss

This chart shows the growth pattern of Sasha who became overweight very early in her life. At age 2, her BMI-for-age was at the 95th percentile and continued to accelerate until age 7. At that point, her parents expressed concern about her eating habits and large body size. Her stature-for-age indicated that she was tall, roughly at the 75th percentile. Her weight continued to increase more rapidly than her height. A medical assessment revealed a family history of diabetes and obesity in both parents. Based on these findings and the parents' readiness to participate in the child's weight management, she was placed on a weight loss program. By age 8, she had averaged 1 pound weight loss per month (a 12-pound loss in one year) and her stature-for-age remained at about the 75th percentile. The dramatic change in the BMI-for-age percentile reflects continued increase in stature, combined with slow steady weight loss that lowered BMI-for-age to the 90th percentile. Notice that the weight-for-age pattern is similar to that of BMI-for-age but the change in BMI-for-age pattern is more dramatic.

Age	Weight	Stature	BMI
2	31 1/2 lb	34"	19.1
3	40 3/4 lb	38"	19.9
4	49 1/2 lb	40 5/8"	21.5
7	88 5/8 lb	50"	25.0
8	76 5/8 lb	52 3/8"	19.8



Summary

- The terms "overweight" and "at risk for overweight" are the preferred terms for children and adolescents with excess body weight that could pose medical risks. A BMI-for-age \geq 95th percentile defines overweight and one between the 85th and 95th percentile defines at risk of overweight. BMI-for-age is age and gender specific.
- A variety of medical consequences, common and uncommon, can accompany overweight and at risk of overweight children and adolescents.
- BMI-for-age is recommended to screen children and adolescents age 2 to 20 to determine if they are overweight. Weight-for-age and stature-for-age add to understanding the BMI-for-age growth pattern.
- To determine underlying causes and consequences of being at risk of overweight and overweight, assessments might include medical history, family history, dietary assessment, physical activity assessment, physical examination, laboratory tests and psychological evaluation.
- Strategies of a management plan are based on information obtained in the assessment. Weight loss is recommended if complications such as hyperlipidemia or hypertension are identified and for children 7 years or older with a BMI-for-age \geq 95th percentile.
- The primary goal of a program to manage uncomplicated overweight is healthy eating and physical activity.

6. REFERENCES AND RESOURCES

American Academy of Pediatrics, 2000. Recommendations for Preventive Pediatric Health Care <http://www.aap.org/policy/periodicity.pdf>

American Diabetes Association. Type 2 diabetes in children and adolescents. *Pediatrics* 2000; 105 (3): 671-680.

Barlow SE and Dietz WH. Obesity evaluation and treatment: Expert committee recommendations, *Pediatrics* 1998 Sep; 102(3): e29. <http://www.pediatrics.org/cgi/reprint/102/3/e29.pdf>

Caprio S, Hyman LD, McCarthy S. Fat distribution and cardiovascular risk factors in obese adolescent girls: importance of the intraabdominal fat depot. *American Journal of Clinical Nutrition*. 1996; 64: 12-17.

Crichlow RW, Seltzer MH, Jannetta PJ. Cholecystitis in adolescents. *Digestive Diseases*. 1972; 17: 68-72.

Daniels SR, Khouury PR, Morrison JA. The utility of body mass index as a measure of body fatness in children and adolescents: differences by race and gender. *Pediatrics* 1997; 99: 804-807.

Dietz WH and Bellizzi MC. Introduction: the use of BMI to assess obesity in children. *American Journal of Clinical Nutrition* 1999; 70 (suppl): 123s-5s.

Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* 1998; 101: 518-525.

Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. *Pediatrics* 1999; 103: 1175-1182.

Garn SM, Lavelle M, Rosenberg KR, Hawthorne VM. Maturation timing as a factor of female fatness and obesity. *American Journal of Clinical Nutrition*. 1986; 43: 879-883.

Hammer LD, Kraemer HC, Wilson DM, Ritter PL, Dornbusch SM. Standardized percentile curves of body-mass index for children and adolescents. *American Journal of Diseases of Children* 1991; 145: 259-263.

Himes JH and Dietz WH. Guidelines for overweight in adolescent preventive services: recommendations form an expert committee. *American Journal of Clinical Nutrition* 1994; 59: 307-316.

Kinugasa A, Tsunamoto K, Furukawa N. Fatty liver and its fibrous changes found in simple obesity of children. *Journal of Pediatric Gastroenterology and Nutrition* 1984; 3: 408-414.

Kleinman, RE, ed., *Pediatric Nutrition Handbook* 4th Edition. 1998. Elk Grove Village, IL: American Academy of Pediatrics.

Lauer RM, Connor WE, Leaverton PE. Coronary heart disease risk factors in school children: the Muscatine study. *Journal of Pediatrics*. 1975; 86: 697-706.

Lissau I, Sorenson TIA. Parental neglect during childhood and increased risk of obesity in young adulthood. *Lancet* 1994; 343: 324-327.

Mallory GB Jr, Fiser D, Jackson R. Sleep-associated breathing disorders in morbidly obese children and adolescents. *Journal of Pediatrics* 1989; 115: 892-897.

Mellbin T, Vuille J-C. Further evidence of an association between psychosocial problems and increase in relative weight between 7 and 10 years of age. *Acta Paediatrica Scandinavica* 1989; 78: 576-580.

Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. Long-term morbidity and mortality of overweight adolescents: A follow-up of the Harvard Growth Study of 1922 to 1935. *New England Journal of Medicine*, 1992; 327: 1350-1355.

National Center for Health Statistics, Centers for Disease Control and Prevention, Health E-Stats, 2001. Prevalence of Overweight among Children and Adolescents: United States, 1999 <http://www.cdc.gov/nchs/releases/01news/overwght99.htm>.

National Heart, Lung, and Blood Institute, 1998. *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*. Bethesda, MD.

Pietrobelli A, Faith MS, Allison DB, Gallagher D, Chiumello G, Heymsfield SB. Body mass index as a measure of adiposity among children and adolescents: A validation study. *Journal of Pediatrics* 1998; 132: 204-210.

Pinhas-Hamiel O, Dolan LM, Daniels SR, Standiford D, Khoury PR, Zeitler P. Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *Journal of Pediatrics* 1996; 128 (5): 608-615.

Power C, Lake JK, Cole TJ. Measurement and long-term health risks of child and adolescent fatness. *International Journal of Obesity* 1997; 21: 507-526.

Richards GE, Cavallo A, Meyer WJ III. Obesity, acanthosis nigricans, insulin resistance, and hyperandrogenemia: pediatric perspective and natural history. *Journal of Pediatrics*. 1985; 107: 893-897.

Riley DJ, Santiago TV, Edelman NH. Complications of obesity-hypoventilation syndrome in childhood. *American Journal of Disabled Children* 1976; 130: 671-674.

Story M, Holt K, Sofka D, eds. 2000. Bright Futures in Practice: Nutrition. Arlington, VA: National Center for Education in Maternal and Child Health. Electronic version: <http://www.brightfutures.org/nutrition/pdf/178-226.pdf>

Stunkard, A, Burt, V. Obesity and body image. II. Age at onset of disturbances in the body image. *American Journal of Psychiatry* 1967; 123: 1443-1447.

Troiano, RP, Flegal KM. Overweight children and adolescents: Description, epidemiology, and demographics. *Pediatrics* 1998; 101: 497-540.

Vajro P, Fontanella A, Perna C, Persistent hyperaminotransferasemia resolving after weight reduction in obese children. *Journal of Pediatrics*. 1994; 125: 239-241.

Van Lenthe FJ, Kemper HCG, van Mecehelen W. Rapid maturation in adolescence results in greater obesity in adulthood: the Amsterdam Growth and Health study. *American Journal of Clinical Nutrition* 1996a; 64: 18-24

Van Lenthe FJ, Kemper HCG, van Mecehelen W. Biological maturation and the distribution of subcutaneous fat from adolescence into adulthood: the Amsterdam Growth and Health study. *International Journal of Obesity* 1996b; 20:121-129.

Wabitsch M, Hauner H, Heinze E. Body-fat distribution and changes in the atherogenic risk-factor profile in obese adolescent girls during weight reduction. *American Journal of Clinical Nutrition* 1994; 60:54-60.

Wanless IR, Bargman JM, Oreopoulos DG, Vas SI. Subcapsular steatonecrosis in response to peritoneal insulin delivery: a clue to the pathogenesis of steatonecrosis in obesity. *Modern Pathology* 1989; 2:69-74.

Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine* 1997; 37 (13):869-873.

Resources

Bright Futures in Practice – Nutrition:

<http://www.brightfutures.org/nutrition/index.html>

Bright Futures in Practice – Physical Activity:

<http://www.brightfutures.org/physicalactivity/pdf/index.html>

Dietary Guidelines for Americans:

<http://www.health.gov/dietaryguidelines/dga2000/dietqd.pdf>

Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People: <http://www.cdc.gov/nccdphp/dash/physact.htm>

GLOSSARY

Acanthosis nigricans: a skin condition characterized by increased pigmentation (darkening of the skin) and hyperkeratosis (thickening of the skin). It occurs most commonly in the skin fold areas behind the knee, in front of elbow, neck, etc.

Cholelithiasis: the presence of stones in the gallbladder. The stones are formed from bile salts, lecithin, and cholesterol. They may be as small as a grain of sand, or become as large as an inch in diameter.

Glucose Intolerance: a carbohydrate intolerance of variable severity: a state in which fasting plasma is < 140 mg/dl and the 30, 60, or 90 minute plasma glucose concentration following a dose of glucose (e.g., from a glucose tolerance test) exceeds 200 mg/dl. Impaired glucose tolerance (IGT) is when the fasting plasma glucose is less than 126 mg/dl and the 2-hour glucose level is between 140 and 199 mg/dl.

Hyperinsulinemia: excessively high blood insulin levels resulting from a variety of conditions including obesity and pregnancy.

Hypertension: Blood pressure is the force of blood against the walls of the arteries recorded as systolic (as the heart beats) and diastolic (as the heart relaxes between beats). Hypertension is defined as: *children and adolescents 1 to 17 years old:* average systolic and/or diastolic blood pressure readings are at or above the 95th percentile (based on age, sex, and height) on at least three separate occasions. (See Tables 16 and 17 at <http://www.brightfutures.org/nutrition/pdf/178-226.pdf>) Children and adolescents between the 90th and 95th percentiles for their age, sex and height are at risk for developing hypertension; *adults:* a consistent reading of 140/90 mm Hg or higher; *adolescents 18 and older* are considered hypertensive based on adult criteria.

Obesity hypoventilation syndrome: also called Pickwickian syndrome, can accompany massive obesity that interferes with the movement of the chest wall and diaphragms. Subsequently this reduces the depth of breathing and results in a decreased ability to oxygenate blood.

Overfat: a triceps skinfold measurement \geq 95th percentile for gender and age.

Pseudotumor Cerebri: a rare disorder characterized by increased pressure within the skull, normal brain ventricle size, and no neurologic focal signs. It is called pseudotumor because the symptoms may mimic a tumor. Frequent symptoms include headache, dizziness, nausea and vomiting.

Sleep Apnea: During sleep, relaxation of the muscles at the base of the throat causes obstruction of the airway, with loud snoring and labored breathing. When complete blockage of the airway occurs, breathing stops and oxygen levels in the blood may fall drastically. Episodes of cessation of breathing last at least 10 seconds during sleep.

Stature: also referred to as height.

[END OF MODULE]